

CLAIMS

1. An apparatus for gasifying a liquid or solid fuel which has a gasifier for producing a thermal decomposed gas by means of a thermal decomposition reaction of the liquid or solid fuel, comprising:
 - 5 heating means for heating water or low-temperature steam, and low-temperature air so as to be high-temperature steam and high-temperature air which have a temperature equal to or higher than 700 deg. C; and
feeding means for feeding said high-temperature steam and said high-temperature air to a thermal decomposition area for thermally decomposing the liquid or solid fuel and/or a reforming area for reforming the thermal decomposed gas.
2. An apparatus according to claim 1, wherein the high-temperature steam and air are introduced into said thermal decomposition area and/or said reforming area by said feeding means, so that said thermal decomposed gas is reformed so as to be a high-temperature syngas with an exothermic reaction between the high-temperature air and carbon compound contained in the thermal decomposed gas and with an endothermic reaction between the carbon compound and said high-temperature steam.
3. An apparatus according to claim 1, wherein said high-temperature steam and air are introduced into said thermal decomposition area by said feeding means, so that said liquid or solid fuel is thermally decomposed to produce said thermal decomposed gas with an amount of sensible heat possessed by the high-temperature steam and air and with an amount of heat generated by an exothermic oxidation reaction between said high-temperature air and said fuel.
4. An apparatus according to one of claims 1 through 3, wherein said heating means includes a steam heating device for heating said low-temperature steam up to a temperature equal to or higher than 700 deg. C so as to be said high-temperature steam, and an air heating device for heating

said low-temperature air up to a temperature equal to or higher than 700 deg. C so as to be said high-temperature air; and

wherein said feeding means includes a high temperature steam supply passage for introducing the high-temperature steam into said thermal decomposition area and/or said reforming area, and a high temperature air supply passage for introducing the high-temperature air into said thermal decomposition area and/or said reforming area.

5. An apparatus according to one of claims 1 through 3, wherein said heating means includes mixing means for mixing said low-temperature steam and said low-temperature air together so as to provide a low-temperature mixture of steam and air, and a mixture heating device for heating said mixture up to a temperature equal to or higher than 700 deg. C so as to be a high-temperature mixture of steam and air; and

wherein said feeding means includes a high-temperature mixture supply passage for introducing the high-temperature mixture into said thermal decomposition area and/or said reforming area.

6. An apparatus according to one of claims 1 through 3, wherein said heating means includes a steam heating device for heating said low-temperature steam up to a temperature equal to or higher than 700 deg. C so as to be said high-temperature steam, an air heating device for heating said low-temperature air up to a temperature equal to or higher than 700 deg. C so as to be said high-temperature air, and mixing means for mixing said high-temperature steam and said high-temperature air together to provide a high-temperature mixture of steam and air; and

wherein said feeding means includes a high temperature mixture supply passage for introducing the high-temperature mixture into said thermal decomposition area and/or said reforming area.

7. An apparatus according to claim 3, wherein said reforming area is defined in a reformer into which said thermal decomposed gas is introduced,

and said feeding means includes passages for introducing said high-temperature air and said high-temperature steam into the reformer and said thermal decomposition area, so that said thermal decomposed gas is reformed to be a high-temperature syngas with an exothermic reaction between the
5 high-temperature air and carbon compound contained in the thermal decomposed gas and with an endothermic reaction between the carbon compound and the high-temperature steam.

8. An apparatus according to claim 2 or 7, wherein a cooling device is provided for cooling said high-temperature syngas to a low-temperature
10 syngas, and the cooling device is provided with a heat-exchanger for generating said low-temperature steam by means of an amount of sensible heat possessed by the high-temperature syngas.

9. An apparatus according to claim 2 or 7, wherein said heating means is constructed by a cooling device which cools said high-temperature syngas to
15 a low-temperature syngas, and the cooling device is provided with a high-temperature heat-exchanger for heating said low-temperature air and/or said low-temperature steam to a high-temperature equal to or higher than 700 deg. C by means of heat-exchange action of the low-temperature air and/or said low-temperature steam with the high-temperature syngas.

20 10. An apparatus according to claim 9, wherein said cooling device is further provided with a mid-temperature heat-exchanger for heating said low-temperature air and/or said low-temperature steam to a mid-temperature in a range between 500 deg. C and 700 deg. C by means of heat-exchange action of the low-temperature air and/or the low-temperature steam with the high-
25 temperature syngas.

11. An apparatus according to claim 10, wherein a cooling device is further provided with a steam-generating heat-exchanger for generating said low-temperature steam by means of heat-exchange action between water and the high-temperature syngas.

12. An apparatus according to claim 2, 7 or 8, wherein gas cleaning means is further provided for cleaning said syngas, and the cleaning means has a syngas supply passage for at least partially feeding a quantity of cleaned up syngas to said heating means so that the heating means heats said
5 water or low-temperature steam and said low-temperature air to a temperature equal to or higher than 700 deg. C by means of heat generated with a combustion reaction of the syngas.

13. An apparatus according to claim 5 or 6, wherein said mixing means includes a mixing control device for allowing a variable setting of a mixing
10 ratio of said steam and air.

14. A method for gasifying a liquid or solid fuel to produce a thermal decomposed gas by means of a thermal decomposition reaction of the liquid or solid fuel:

wherein water or low-temperature steam, and low-temperature air are
15 heated so as to be high-temperature steam and high-temperature air which have a temperature equal to or higher than 700 deg. C; and

wherein said high-temperature steam and said high-temperature air are introduced into a thermal decomposition area for thermally decomposing the liquid or solid fuel and/or a reforming area for reforming the thermal
20 decomposed gas.

15. A method according to claim 14, wherein said high-temperature steam and said high-temperature air are mixed with said thermal decomposed gas, so that an amount of heat required for an endothermic reforming reaction between said high-temperature steam and carbon compound contained in the
25 thermal decomposed gas is partially supplied by an amount of heat generated with an exothermic reaction between the high-temperature air and the carbon compound.

16. A method according to claim 14, wherein said high-temperature steam and air are introduced into said thermal decomposition area, so that

said liquid or solid fuel is thermally decomposed to produce said thermal decomposed gas with an amount of sensible heat possessed by the high-temperature steam and air and with an amount of heat generated by an exothermic oxidation reaction between said high-temperature air and said fuel.

17. A method according to claim 14, wherein a mixing ratio of said high-temperature steam and air is set to be a mixing ratio which can be variably controlled.

18. A method according to one of claims 14 through 17, wherein normal air, oxygen or mixture of the normal air and oxygen is used as said low-temperature air.

19. A method according to one of claims 14 through 16, wherein said thermal decomposed gas takes a steam reforming reaction in said reforming area and thereafter, takes a heat-exchange action with said low-temperature steam and/or said low-temperature air to heat the low-temperature steam and/or the low-temperature air up to said temperature equal to or higher than 700 deg.C.

20. A method according to claim 19, wherein said thermal decomposed gas further takes a heat-exchange action with said low-temperature steam and/or said low-temperature air to heat the low-temperature steam and/or the low-temperature air up to a temperature in a range between 500 deg. C and 700 deg. C.

21. A method according to claim 20, wherein said thermal decomposed gas further takes a heat-exchange action with water to generate said low-temperature steam.

22. A method according to one of claims 14 through 18, wherein said thermal decomposed gas takes a steam reforming reaction in said reforming area and then, undergoes a gas treatment process for removing foreign matters or harmful substances therefrom so as to be a cleaned up syngas and

thereafter, the cleaned up syngas is delivered to heating means for heating said water or low-temperature steam and said low-temperature air as well as delivered to a combustion device of a combustion facility or engine residing outside the apparatus; and

5 wherein said water or low-temperature steam and said low-temperature air are heated in the heating device by heat generated with a combustion reaction of the cleaned up syngas.

23. A method according to 22, wherein said cleaned up syngas is supplied to said combustion device so as to be used as a main fuel thereof.

10 24. A method according to 22, wherein said cleaned up syngas is supplied to said combustion device so as to be used as an auxiliary fuel to be added to a main fuel of the combustion device and/or combustion air thereof.

25. A method according to one of claims 22 through 24, wherein said thermal decomposed gas flows through a cooling device for cooling the
15 thermal decomposed gas after taking said steam reforming reaction and before undergoing said gas treatment process; and

 wherein the cooling device evaporates a quantity of water so as to generate said low-temperature steam by means of sensible heat possessed by the thermal decomposed gas, or heats said low-temperature steam and/or said
20 low-temperature air by means of the sensible heat of the thermal decomposed gas.

26. A method according to one of claims 14 through 25, wherein waste, coal, biomass fuel or heavy oil is used as said liquid or solid fuel.

27. A waste gasifying system comprising an apparatus for gasifying a
25 liquid or solid fuel according to one of claims 1 through 13.

28. A coal gasifying system comprising an apparatus for gasifying a liquid or solid fuel according to one of claims 1 through 13.

29. A gasification and power generation system comprising an apparatus for gasifying a liquid or solid fuel according to one of claims 1 through 13,

and a electric power generator operated with use of a syngas produced by said apparatus.